

WHAT IS CLAIMED IS:

1. In a wireless communication system for transmitting and receiving data by using a multipath fading channel, an OFDM (orthogonal frequency division multiplexing) wireless communication system comprising:

5 a transmitter for performing IDFT (inverse discrete Fourier transform) on an information transmit vector at least twice to modulate it into an OFDM (orthogonal frequency division multiplexing) signal, transmitting the modulated OFDM signal through a multipath fading channel, modulating a pilot symbol vector for predicting an amplitude and a phase of the multipath fading channel
10 into an OFDM signal, and transmitting the modulated OFDM signal through the multipath fading channel; and

 a receiver for demodulating the pilot symbol vector received through the multipath fading channel to predict the amplitude and the phase of the multipath fading channel, using the predicted amplitude and phase to
15 compensate the amplitude and the phase multiplied to the received information transmit vector, performing DFT (discrete Fourier transform) on the compensated information transmit vector to average a noise signal value increased by the channel compensation in a specific interval with an amplitude of the channel with less than a mean value into a mean value within an OFDM
20 symbol interval, and outputting the mean value.

2. The OFDM wireless communication system of claim 1, wherein the transmitter comprises:

 a mapper for mapping an externally received binary information sequence to symbols according to the MQAM (M-ary quadrature amplitude

modulation) method;

a serial to parallel converter for converting the mapped symbols into vector data that are information transmit vectors;

a first IDFT unit for performing IDFT on the converted information transmit vectors;

a second IDFT unit for performing IDFT on the IDFT-performed signals to modulate them into OFDM signals;

a third IDFT unit for modulating a pilot symbol vector for predicting the amplitude and phase of the multipath fading channel into an OFDM signal; and

a parallel to serial converter and guard interval inserter for inserting a guard interval into the signal received from the second IDFT unit, converting the guard interval inserted information transmit vector into a serial signal and transmitting it, and converting the guard interval inserted pilot symbol vector into a serial signal and transmitting it.

3. The OFDM wireless communication system of claim 2, wherein the receiver comprises:

a guard interval eliminator and serial to parallel converter for eliminating the guard interval from the converted and received serial signal, and converting the guard interval eliminated serial signal into an information transmit vector and a pilot symbol vector respectively;

a first DFT unit for demodulating the converted information transmit vector into an OFDM signal;

a third DFT unit for demodulating the converted pilot symbol vector into an OFDM signal;

a channel predictor and interpolator for predicting the amplitude and phase of the multipath fading channel using the demodulated pilot symbol vector;

a channel compensator for compensating the amplitude and phase of the channel multiplied to the demodulated information transmit vector according to the predicted amplitude and phase of the channel;

a second DFT unit for performing DFT on the compensated channel signal, and averaging a noise signal value which becomes enhanced in a specific interval with an amplitude of the channel with less than a mean value, to a mean value within a symbol interval;

a parallel to serial converter for converting the signal received from the second DFT unit into a serial signal; and

a decoder for restoring the converted serial signal into a binary information sequence, and outputting the binary information sequence.

4. The OFDM wireless communication system of claim 2, wherein the channel compensator compensates the amplitude and phase of the channel through the MMSE (minimum mean square error) equalization method using the predicted amplitude and phase of the channel, and the MMSE equalization method satisfies the equation:

$$\hat{\mathbf{x}}_i^j(k) = \frac{r_i^j(k) \hat{H}_i^{j*}(k)}{|\hat{H}_i^{j*}(k)|^2 + \sigma_w^2 / \sigma_x^2 + \sigma_l^2}$$

where $\hat{H}_i^{j*}(k)$ is the predicted amplitude and phase of the channel, σ_w^2 and σ_x^2 are mean power values of the OFDM signal and an AWGN (additive

white Gaussian noise) signal, and σ_I^2 is a mean power value of an ICI (interchannel interference) signal.

5 The OFDM wireless communication system of claim 4, wherein the channel compensator compensates the amplitude and phase of the channel through the ZF (zero forcing) equalization method using the predicted amplitude and phase of the channel, and the ZF equalization method satisfies the equation:

$$\hat{\mathbf{x}}_i^j(k) = \frac{r_i^j(k) \hat{H}_i^{j*}(k)}{|\hat{H}_i^{j*}(k)|^2}.$$

10 The OFDM wireless communication system of claim 4, wherein the channel compensator compensates the amplitude and phase of the channel through a gain limit equalization method using the predicted amplitude and phase of the channel, and the gain limit equalization method satisfies the equation:

$$\hat{\mathbf{x}}_i^j(k) = \frac{r_i^j(k) \hat{H}_i^{j*}(k)}{|\hat{H}_i^{j*}(k)|^2 + \sigma}$$

15 where σ is a constant used for gain limits.

7. A wireless communication system including a transmitter for transmitting data using a multipath fading channel and a receiver for receiving them from the transmitter, comprising:

20 a mapper for mapping an externally received binary information sequence to at least one symbol according to the MQAM (M-ary quadrature amplitude modulation) method;

a serial to parallel converter for converting the mapped symbols into vector data which are information transmit vectors;

a first IDFT (inverse discrete Fourier transform) unit including at least one (preferably M) IDFT unit for performing IDFT on the converted information transmit vectors;

an interleaver for writing subchannel values of the respective transmit vectors received from the IDFT unit in an MxN memory buffer in the first direction;

a second IDFT unit including at least one (preferably M) IDFT unit for reading the subchannel values written in the first direction in the second direction when the writing in the first direction is finished, performing IDFT on the read subchannel values, and modulating them to OFDM (orthogonal frequency division multiplexing) signals;

a third IDFT unit for modulating a pilot symbol vector for predicting an amplitude and a phase of the multipath fading channel to an OFDM signal; and

a parallel to serial converter and guard interval inserter for inserting a guard interval into the signal received from the second IDFT unit, converting the guard interval inserted information transmit vector into a serial signal, transmitting the serial signal, converting the guard interval inserted pilot symbol vector into a serial signal, and transmitting it to the transmitter.

8. The wireless communication system of claim 7, further comprising:

a guard interval eliminator and serial to parallel converter for eliminating the guard interval from the converted and received serial signal, and converting the guard interval eliminated serial signal into an information

transmit vector and a pilot symbol vector respectively;

a first DFT unit including at least one DFT unit for demodulating the converted information transmit vector into an OFDM signal;

a third DFT unit for demodulating the converted pilot symbol vector into an OFDM signal;

a channel predictor and interpolator for predicting the amplitude and phase of the multipath fading channel using the demodulated pilot symbol vector;

a channel compensator for compensating the amplitude and phase of the channel multiplied to the demodulated information transmit vector according to the predicted amplitude and phase of the channel;

a deinterleaver for writing the compensated channel signals in an MxN memory buffer in the first direction;

a second DFT unit including at least one (preferably M) DFT unit for reading the signal with less channel autocorrelations in the second direction from among the channel compensated signals written in the first direction, performing DFT on the read signals, and demodulating them into OFDM signals;

a parallel to serial converter for converting the demodulated signals into serial signals; and

a decoder for restoring the converted serial signals into a binary information sequence, and outputting the binary information sequence.

9. The wireless communication system of claim 8, wherein the interleaver sequentially writes subchannel values of the received transmit vector

in the $M \times N$ memory buffer in the vertical direction (temporal direction), and

the deinterleaver sequentially writes the channel compensated signals in the $M \times N$ memory buffer in the diagonal direction (temporal direction).

10. The wireless communication system of claim 8, wherein the interleaver sequentially writes subchannel values of the received transmit vector in the $M \times N$ memory buffer in the diagonal direction (temporal direction and frequency direction), and

the deinterleaver sequentially writes the channel compensated signals in the $M \times N$ memory buffer in the diagonal direction (temporal direction and frequency direction).

11. The OFDM wireless communication system of claim 3, wherein the transmitter comprises:

M N_1 -point IDFT units (where N_1 is a number less than a number N , and $N = MN_1$); and

an interleaver of an $M \times N_1$ memory buffer for receiving a signal from the first IDFT unit and applying the signal to the second IDFT unit, and

the receiver comprises:

M N_1 -point DFT units (where N_1 is a number less than a number N , and $N = MN_1$); and

a deinterleaver of an $M \times N_1$ memory buffer for receiving a signal from the first DFT unit and applying the signal to the second DFT unit.

12. The wireless communication system of claim 8, wherein the transmitter comprises:

$L \times M$ N_1 -point IDFT units (where N_1 is a number less than a number N ,

and $N=MN_l$); and

an interleaver of an $L \times M \times N_l$ memory buffer for receiving a signal from the first IDFT unit and applying the signal to the second IDFT unit, and

the receiver comprises:

5 $L \times M$ N_l -point DFT units (where N_l is a number less than a number N , and $N=MN_l$); and

a deinterleaver of an $L \times M \times N_l$ memory buffer for receiving a signal from the first DFT unit and applying the signal to the second DFT unit.

10 13. A method for compensating a channel in a wireless communication system for transmitting and receiving data using a multipath fading channel, comprising:

(a) performing IDFT (inverse discrete Fourier transform) on a vector for information transmission to modulate the vector into an OFDM (orthogonal frequency division multiplexing) signal, and transmitting the modulated signal
15 through the multipath fading channel;

(b) modulating a pilot symbol vector for predicting an amplitude and a phase of the multipath fading channel into an OFDM signal, and transmitting the modulated signal through the multipath fading channel;

(c) demodulating the pilot symbol vector received through the multipath
20 fading channel to predict the amplitude and the phase of the multipath fading channel;

(d) compensating the amplitude and the phase of the channel multiplied to the received information transmit vector by using the predicted amplitude and the phase of the channel; and

(e) performing DFT on the compensated channel signal, averaging a noise signal value enhanced by the channel compensation in a specific interval with an amplitude of the channel with less than a mean value into a mean value within an OFDM symbol interval, and outputting the mean value.

5 14. The method of claim 13, wherein (e) comprises using the MMSE (minimum mean square error) equalization method to compensate the amplitude and the phase of the channel multiplied to the received transmit vector.

10 15. The method of claim 13, wherein (e) comprises using the ZF (zero forcing) equalization method to compensate the amplitude and the phase of the channel multiplied to the received transmit vector.

 16. The method of claim 13, wherein (e) comprises using the gain limit equalization method to compensate the amplitude and the phase of the channel multiplied to the received transmit vector.

15 17. The method of claim 13, wherein (a) comprises:
writing the subchannel values of the information transmit vector in an MxN memory buffer in the first direction; and
reading the subchannel values in the second direction when the writing in the first direction is finished.

20 18. The method of claim 17, wherein (e) further comprises:
writing the compensated channel signals in the MxN memory buffer in the first direction; and
reading the signals with less autocorrelations of the channel in the second direction from among the channel compensated signals written in the

first direction.

19. The method of claim 17, wherein the writing in the first direction comprises writing the subchannel values of the information transmit vector or the channel compensated signals in the $M \times N$ memory buffer in the vertical direction (temporal direction).

20. The method of claim 17, wherein the writing in the first direction comprises writing the subchannel values of the information transmit vector or the channel compensated signals in the $M \times N$ memory buffer in the diagonal direction (temporal direction and frequency direction).

21. The wireless communication system of claim 8, wherein the transmitter and the receiver comprise an $M \times N$ -point IDFT unit and an $M \times N$ -point DFT unit, respectively, and a noise reduction mean interval of the receiver is extended to $M \times N$ points by using the $M \times N$ memory buffer of the transmitter.

22. The OFDM wireless communication system of claim 2, wherein the parallel to serial converter and guard interval inserter inserts a guard interval into the information transmit symbol vector received from the serial to parallel converter, converts the guard interval inserted information transmit symbol vector into a serial signal, and transmits the serial signal.

23. The OFDM wireless communication system of claim 2, wherein the parallel to serial converter and guard interval inserter performs IDFT on the pilot symbol vector with the minimum PAR (peak to average ratio), inserts a guard interval into the converted pilot symbol vector, converts the guard interval inserted pilot symbol vector into a serial signal, and transmits the serial signal.

24. The OFDM wireless communication system of claim 23, wherein

the pilot symbol vector optimized with respect to the PAR is modulated through the IDFT and stored in the memory, and when necessary, the parallel to serial converter and guard interval inserter reads the stored pilot symbol vector, converts the pilot symbol vector, and transmits the converted pilot symbol vector.

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